

Risks of Urban Agriculture: Lead and Cadmium Intake by Kigali Residents from Locally Grown Produce

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Abstract

This study determined the concentrations of lead and cadmium in edible parts of *Colocasia esculenta*, *Amaranthus spp.* and *Ipomoea batata* cultivated on farms in industrially polluted sections of Nyabugogo Marsh in Kigali, Rwanda. The concentrations in all three crops exceeded European Union (EU) standards for metal concentration in food crops. *C. esculenta* roots (Taro) contained the highest concentration of lead (1.02 mg kg^{-1}) and cadmium (0.56 mg kg^{-1}), approximately ten and six times over the EU limits, respectively. Even though *I. batata* (sweet potato) contained the lowest concentrations of lead (0.75 mg kg^{-1}), this is almost eight times the upper limit. The highest bioaccumulation factors (the ratio of plant metal concentration to that of the soil in which it is found growing) for both metals were observed in amaranth plants. The concentrations of lead and cadmium in the farm soils were all acceptable based on EU standards (300 mg kg^{-1} for lead and 3 mg kg^{-1}

for cadmium) with the highest being $285 \pm 28.05 \text{ mg kg}^{-1}$ and $1.75 \pm 0.38 \text{ mg kg}^{-1}$, respectively.

The average daily consumption by an adult in the community living around the Marsh and where some of the produce is sold is 50g of amaranth, 120g of taro and 180g of sweet potato. Based on the metal concentration and these rates of consumption, the daily dietary intake of lead by an adult in the community from amaranth, taro and sweet potato is 1×10^{-4} , 3×10^{-4} and $4 \times 10^{-4} \text{ mg kg}^{-1}$ respectively. The daily intake of cadmium is 4×10^{-4} , 1.7×10^{-4} and $1.2 \times 10^{-4} \text{ mg kg}^{-1}$ for amaranth, taro and sweet potato respectively. These metal intakes are well within the recommendations set forth by the World Health Organisation.

The community also has access to multiple sources of dietary and non dietary zinc such as beans, milk and rain water collected from zinc coated roofing sheets, which serves to ameliorate the effects of cadmium. It is however worth noting that survey data may have yielded overestimates of these zinc sources, due to the conditions under which the surveys were conducted i.e. in the hearing of neighbors due to the cramped nature of housing, which may have prompted respondents to inflate consumption quantities of expensive food items.

The calculated maximum recommended quantities for daily intake of the crops are very large and are unlikely to be consumed by the population i.e. $>2\text{kg}$ of amaranth, $>2 \text{ kg}$ of taro and 3 kg of sweet potato per day for an adult. Additionally, because this

is a poor community, access to such quantities of food on a daily basis is not likely. The community is therefore not exposed to health risks from consuming metal contaminated crops, largely because of the small quantities consumed. The local population is therefore at no immediate risk to exceeding metal consumption limits by consuming vegetables grown in the Nyabugogo Marsh, but the threats will likely increase if the pollution of the Marsh is not addressed.

Key words: Health risk, urban farming, heavy metals, *Colocasia esculenta*, *Amaranthus spp.*, *Ipomoea batata*, wetlands, Rwanda.